Spurious oscillations in an index-3 DAE solver for constrained mechanical systems

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Generalized-α time integration methods are quite popular in structural dynamics and may be extended straightforwardly to constrained mechanical systems that are desribed by 2nd order index-3 DAEs. From the pure numerical viewpoint, the methods should be combined with some kind of index reduction to avoid the well known problems of higher index DAE time integration. On the other hand, the direct application to the original index-3 formulation of the equations of motion allows a more direct implementation of generalized-α methods in existing industrial simulation tools.

We will show that these methods suffer from order reduction and spurious oscillations in the initial phase of time integration. Order reduction may be avoided by perturbed starting values or by a modified first time step that guarantees second order convergence for reasonable values of algorithmic parameters.